

Lepidoptera *Original No. 100 of 500*

OBERLIN COLLEGE
DEPARTMENT OF ZOOLOGY

PRESERVE FOR FUTURE REFERENCE.

Commonwealth of Massachusetts.

515.78
Mass.

Kirkland

THE GYPSY AND BROWN-TAIL MOTHS.

BULLETIN No. 2.

ISSUED FROM THE OFFICE OF THE SUPERINTENDENT FOR SUPPRESSING
THE GYPSY AND BROWN-TAIL MOTHS.

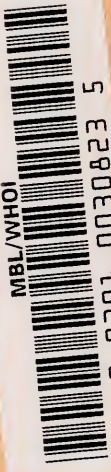


BOSTON:
WRIGHT & POTTER PRINTING CO., STATE PRINTERS,
18 POST OFFICE SQUARE.

1906.

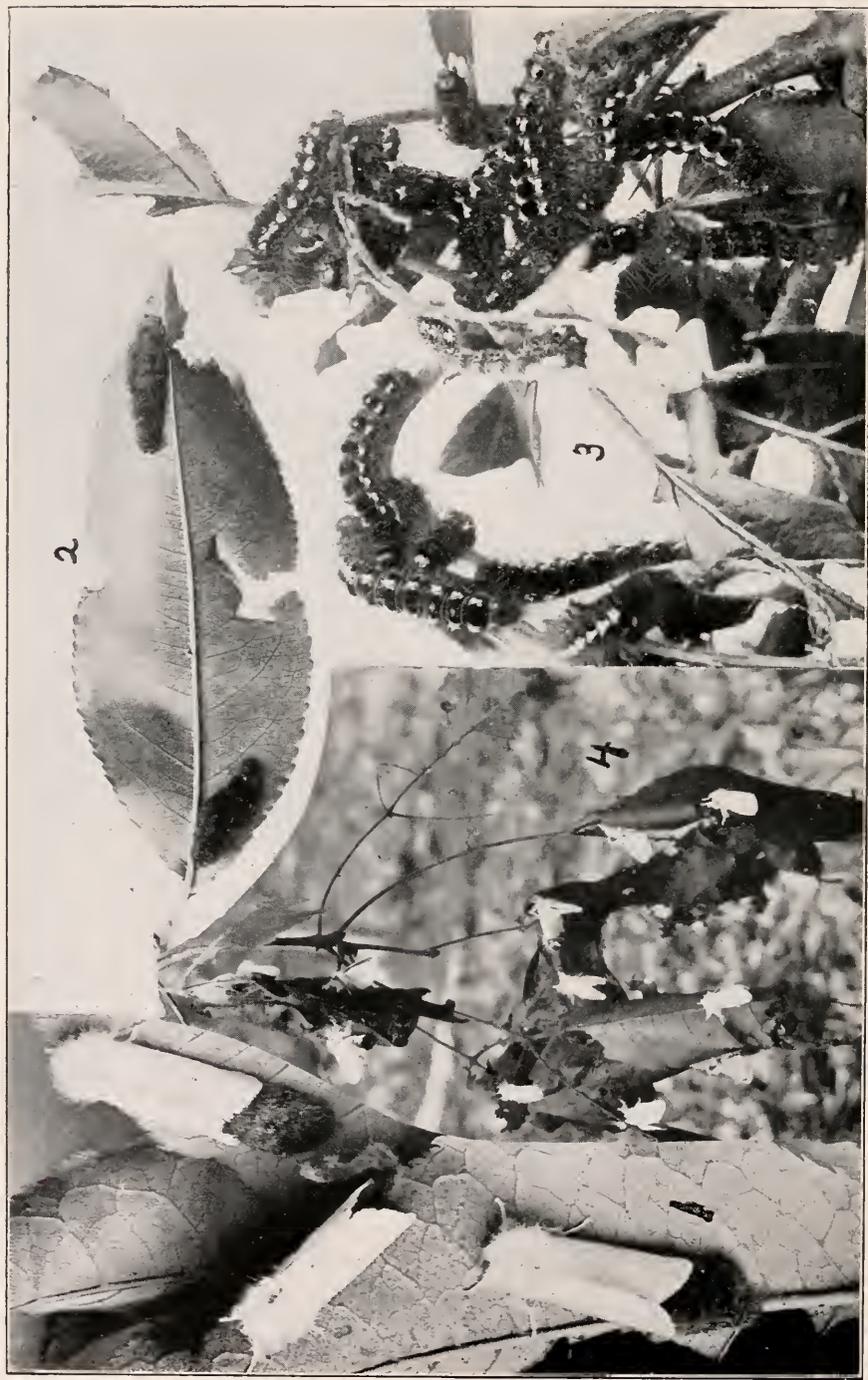
QL
548
M 312

MBL/WHOI



0 0301 0030823 5





Various stages of the brown-tail moth.

1. Female moths laying eggs (slightly enlarged).
2. Egg masses.
3. Caterpillars.
4. Cocoons in hickory leaves, with male and female moths emerging (much reduced).

Commonwealth of Massachusetts.

THE GYPSY AND BROWN-TAIL MOTHS.

BULLETIN No. 2.

ISSUED FROM THE OFFICE OF THE SUPERINTENDENT FOR SUPPRESSING
THE GYPSY AND BROWN-TAIL MOTHS.



BOSTON:
WRIGHT & POTTER PRINTING CO., STATE PRINTERS,
18 POST OFFICE SQUARE.

1906.

APPROVED BY
THE STATE BOARD OF PUBLICATION.

Commonwealth of Massachusetts.

OFFICE OF SUPERINTENDENT FOR
SUPPRESSING THE GYPSY AND BROWN-TAIL MOTHS.

The gypsy and brown-tail moths — destructive, introduced foreign insects — by act of the Legislature of Massachusetts have been declared public nuisances and their suppression authorized and required.

Under chapter 381 of the Acts of 1905, printed in full at the end of this bulletin, certain duties in the suppression of the gypsy and brown-tail moths devolve upon the Commonwealth of Massachusetts, upon its cities and towns and upon its citizens as individuals.

This bulletin is issued by the State Superintendent for Suppressing the Gypsy and Brown-tail Moths for the guidance of cities and towns and of individual citizens in the work of suppression. To this end, certain essential facts concerning the two insects are herewith presented. It is hoped that a perusal of the bulletin will give city and town officials, and individual property owners as well, a clear idea of their rights and duties under the act. It is incumbent on all citizens to familiarize themselves with the appearance and habits of the moths and the means best suited for destroying them. Any insects suspected to be either gypsy or brown-tail moths will be gladly identified at this office, and requests for information or advice will receive prompt attention.

The present bulletin is substantially a reprint of Bulletin No. 1, issued Sept. 1, 1905, of which an edition of 25,000 copies has become exhausted. A number of new illustrations are included. The amended law is printed in full and certain additions to the text have been made which it is hoped will make the pamphlet more generally useful to those engaged in protecting their trees from injury by the moth pests.

A. H. KIRKLAND,
Superintendent.

6 BEACON STREET, BOSTON, MASS.,
Aug. 15, 1906.



Menotomy Rocks Park, Arlington, devastated by gypsy moth caterpillars, June, 1905.



Pines, Lebanon Street, Malden, stripped by gypsy moth caterpillars in 1904; dead in 1905.

THE GYPSY AND BROWN-TAIL MOTHS.

THE GYPSY MOTH.

As far back as authentic records exist, the gypsy moth has been a destructive insect pest in Europe; at times increasing enormously and disastrously, then for other periods decreasing, only to increase again and renew its extensive ravages. At the present time it is most numerous and destructive in southern Russia.

Up to the year 1868 the gypsy moth was not known to exist anywhere within the western hemisphere. In that year the insect was brought from Europe by an experimenter to Medford, Mass. Soon escaping, it spread into many cities and towns of eastern Massachusetts, and, increasing enormously, became in 1890 so serious a pest that the Commonwealth began exterminative work against it. This was continued for ten years. By 1900 the State work had so reduced the moth that it was doing little or no serious damage, and had, indeed, ceased to be generally noticed, having been exterminated in many places. The Commonwealth then abandoned its operations against the insect; whereupon it rapidly gained headway, and soon became again a formidable menace. To-day, in many localities, the gypsy moth occurs in enormous numbers, as it did in 1890, but it is found over a much larger territory than it occupied at that time.

The Damage caused by the Gypsy Moth.

The gypsy moth caterpillar will attack all fruit, shade and woodland trees. It shows a preference for the apple, white oak, red oak, willow and elm. It will devour on occasion nearly every useful grass, plant, flower, shrub, vine, bush, garden or field crop that grows in Massachusetts.

The caterpillar kills both deciduous and coniferous trees. Woodlands assailed by it in formidable numbers are stripped bare, as in winter, and many trees are killed. While several consecutive strippings are usually necessary to cause the death of a healthy deciduous tree, one thorough stripping will kill the white pine and other coniferous trees. Where the gypsy moth abounds in residential districts, it not only eats nearly everything green, but it swarms, in caterpillar form, upon houses, walks and verandas and often enters dwellings. In residential districts most heavily infested by the moth real estate tends to rapid depreciation, so that it sometimes becomes a matter of difficulty to rent or sell property.

Life History.

The gypsy moth, like all insects of its class, exists under four different forms during the year.

The Egg.—The eggs of the gypsy moth are laid in July and August in a yellowish, hair-covered mass averaging about one and one-half inches long and about three-fourths of an inch wide. To the eye the egg mass resembles a small, tightly stuffed, oval, buff-colored cushion. During winter the color often fades to a dingy white. In this mass, the eggs, to the average number of about five hundred, are closely packed with yellowish hair from the body of the female moth. An individual egg is scarcely as large as a pinhead, salmon-colored when first laid, but turning dark in the course of a few weeks.



FIG. 1.—Egg cluster of gypsy moth.

The Caterpillar or Larva.—The eggs hatch about May 1, and each mass or “cluster” yields a swarm of small caterpillars, the bulk of which become fully grown by midsummer. Gypsy moth caterpillars of any age are decidedly hairy. The head of the caterpillar is large in proportion to its body, this being especially noticeable when it is young.

The mature caterpillar has a dusky or sooty-colored body. Along the back, counting from the head, which is marked with yellow, is a double row of blue spots followed by a double row of red spots. This double row of spots almost invariably may be seen very distinctly on the back of a gypsy moth caterpillar which has attained a length of one inch and a half or more. There are five pairs of blue spots and six pairs of red spots. No other New England larva has this double row of blue and red spots along its back. Until the gypsy moth caterpillar grows to the length of an inch and a half, however, it does not always show very distinctly these pairs of spots. The mature gypsy moth caterpillar not infrequently attains a length of three inches.

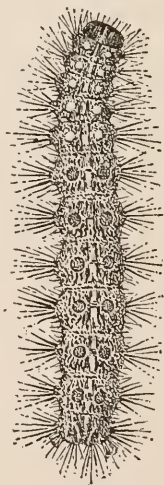


FIG. 2.—Full-grown caterpillar of the gypsy moth.



Various stages of the gypsy moth.
 1. Full-grown caterpillars. 2. Pupa. 3. Female moth laying egg cluster.
 All figures life size.



Work of killing the eggs of the gypsy moth in woodland.
Massachusetts Board of Agriculture Report, 1898.

The Pupa. — When fully grown, usually in July, the caterpillar spins a few threads of silk as a supporting framework, casts its skin and changes into a pupa, or, as it is sometimes called, a chrysalis. The pupa is dark reddish or chocolate in color and very thinly sprinkled with light reddish hairs. Unfortunately it resembles the pupæ of certain other moths found in Massachusetts, and cannot, unless by experts, be identified at a glance. The thinly sprinkled, light reddish hairs are, however, characteristic.

The Moth. — From July 15 to August 15 the winged moths emerge from the pupæ, the date varying according to the season and time of pupation. The male moth is brownish-yellow, varying to greenish-brown in color, has a slender body and expands about one and one-half inches. It flies actively by day, with a peculiar zigzag flight.

The female moth is nearly white, with numerous small black markings, heavy bodied and sluggish, and expands about two inches. The female does not fly, otherwise the spread of the gypsy moth would be most rapid. After mating, the moths live but a short time. The female dies after depositing her egg mass. The winged moths take no food. All damage to foliage is caused by the caterpillars.



FIG. 4. — Male gypsy moth.



FIG. 3. — Pupa of gypsy moth.

Distribution.

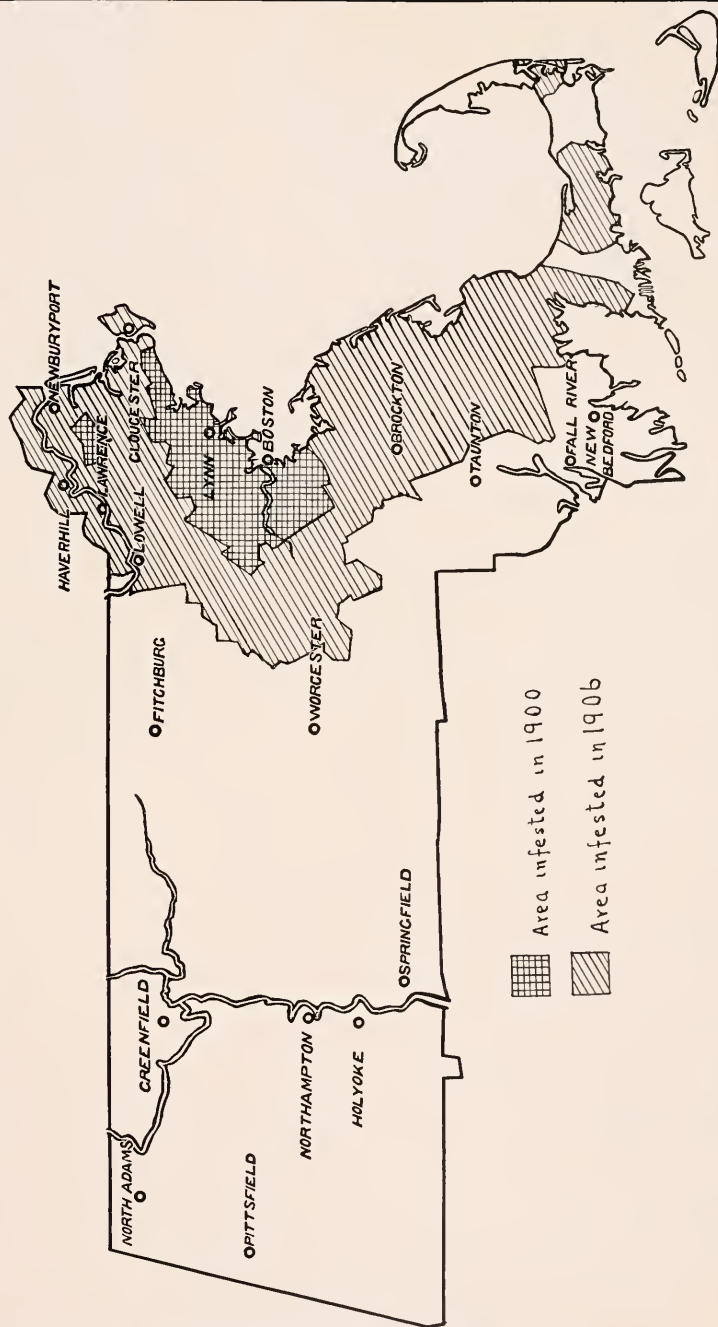
The gypsy moth spreads chiefly during the caterpillar stage. While the caterpillars do not crawl very far from where they hatch, except when there is a scarcity of food, they have the habit, when small and young, of spinning down on their silken threads from trees, and, falling on vehicles, are then carried from place to place. Electric cars, pleasure and business vehicles, bicycles and automobiles are common means of thus transporting the gypsy moth. The special attention of all those upon whom gypsy moth suppression devolves is therefore directed to the necessity of keeping the neighborhoods of travelled highways free from the insect. The caterpillars often crawl upon

vehicles standing in an infested spot, and by this means also are carried from one place to another. The egg clusters of the gypsy moths may also be transported upon any of the numerous objects on which they are laid. Freight cars that have stood near infested foliage for a period long enough for the laying of gypsy moth eggs upon them may even thus transport the pest. The gypsy moth is now found in the following cities and towns:—

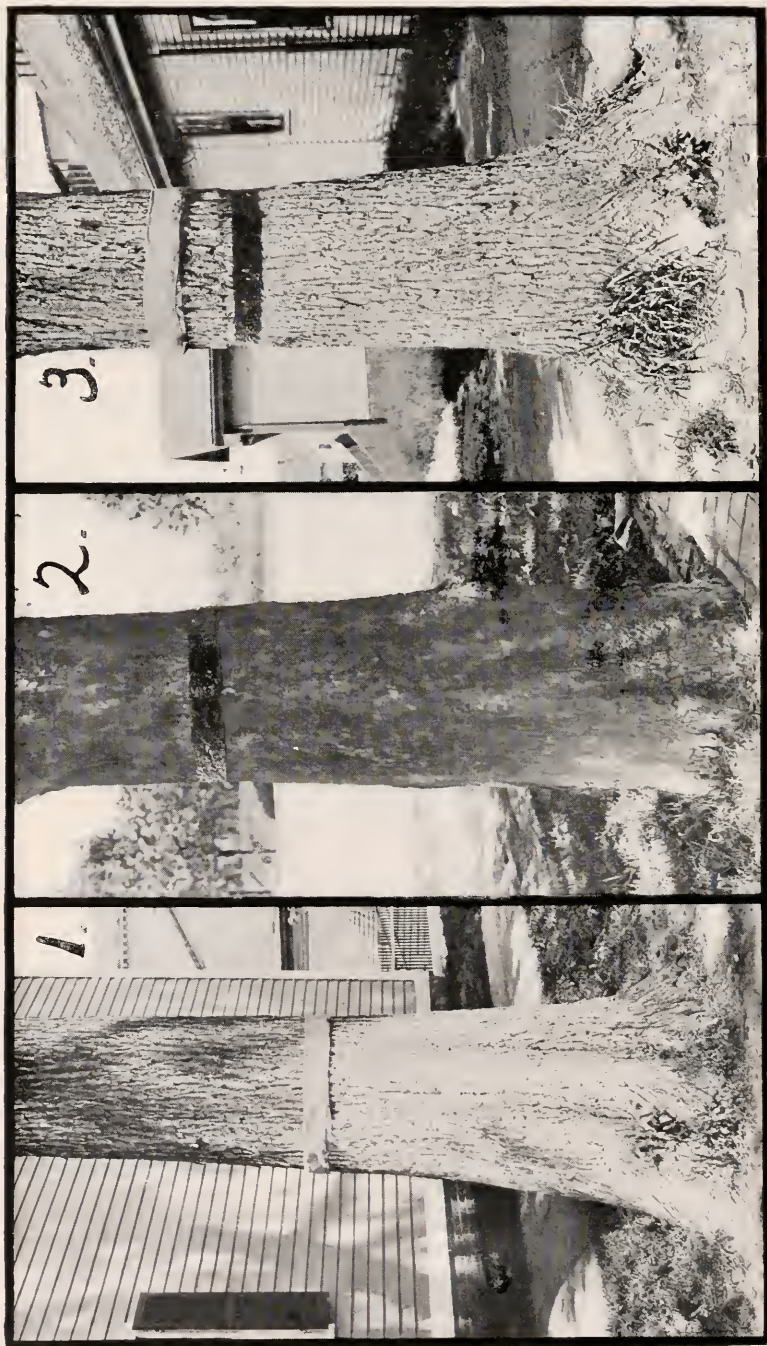
List of Cities and Towns infested by the Gypsy Moth.

Abington.	Hanson.	Pembroke.
Acton.	Haverhill.	Plymouth.
Amesbury.	Hingham.	Plympton.
Andover.	Holbrook.	* Quincy.
* Arlington.	Holliston.	Randolph.
Ashland.	Hopkinton.	* Reading.
Avon.	Hudson.	* Revere.
Ayer.	Hull.	Rockland.
Barnstable.	Hyde Park.	Rockport.
Bedford.	Ipswich.	Rowley.
* Belmont.	Kingston.	* Salem.
* Beverly.	Lakeville.	Salisbury.
Billerica.	Lawrence.	* Saugus.
* Boston.	* Lexington.	Scituate.
Bourne.	Lincoln.	Sherborn.
Boxford.	Lowell.	* Somerville.
Braintree.	* Lynn.	Southborough.
Bridgewater.	* Lynnfield.	* Stoneham.
Brockton.	* Malden.	Stoughton.
* Brookline.	* Manchester.	Stow.
* Burlington.	* Marblehead.	Sudbury.
* Cambridge.	Marlborough.	* Swampscott.
Canton.	Marshfield.	Tewksbury.
Carlisle.	Maynard.	Topsfield.
Carver.	* Medford.	* Wakefield.
Chelmsford.	* Melrose.	* Waltham.
* Chelsea.	Merrimac.	Wareham.
Cohasset.	Methuen.	* Watertown.
Concord.	Middleborough.	Wayland.
* Danvers.	Middleton.	Wellesley.
Dedham.	Millis.	Wenham.
Dever.	Milton.	West Bridgewater.
Dracut.	* Nahant.	Westborough.
Duxbury.	Natick.	Westford.
East Bridgewater.	Needham.	West Newbury.
* Essex.	Newbury.	Weston.
* Everett.	Newburyport.	Westwood.
Framingham.	* Newton.	Weymouth.
Georgetown.	North Andover.	Whitman.
* Gloucester.	North Reading.	Wilmington.
Groveland.	Norwell.	* Winchester.
Halifax.	Norwood.	* Winthrop.
Hamilton.	Orleans.	* Woburn.
Hanover.	* Peabody.	Yarmouth.

* Indicates the cities and towns which constitute the heavily infested central district.



Gypsy moth infested district in Massachusetts: 1900, 359 square miles; 1906, 2,287 square miles.



Methods of banding trees infested with the gypsy moth.
1. Burlap. 2. Sticky band. 3. Combination of burlap and sticky band.

There can be little doubt that the gypsy moth occurs over a considerably larger area than the foregoing. Owing to the existence of large colonies of the moth on main lines of travel in eastern Massachusetts, it seems probable that the insect will be found ultimately at least throughout the eastern part of the State. Outside the State it now occurs in southeastern New Hampshire, Providence, R. I., and Stonington, Ct.

Where to look for the Gypsy Moth.

The Egg. — From August to May the egg masses of the gypsy moth may be found in places near which the moth emerged from the pupa case. In laying, the female moth chooses tree trunks, the under sides of limbs, sheltered crotches and holes in trees, hollow trees, crevices in or under rough bark, etc. The egg clusters are also found on shrubbery, buildings, scattered and heaped rubbish, barrels, boxes and similar objects standing out of doors, wood piles, stone piles, fences, walls, boulders and the like. Gypsy moth egg clusters have been found upon an immense variety of objects, and occasionally may be seen in almost any situation that is not too far from vegetation. The tendency is to deposit the eggs on the lower or inner surface of an object. The moths disregard all rules when they swarm in a place, and their egg clusters may then be found plentifully in sight as well as out, and in all sorts of places, even within buildings.

The Caterpillar. — From May to August the caterpillars may be found in various stages of growth, diminishing in numbers rapidly after July 15. In the spring the small caterpillars should be looked for on the foliage, feeding principally on the under side of the leaf. As the caterpillars grow, they molt or cast their skin several times, and these molted skins are characteristic signs of the presence of the moth. As the caterpillars acquire size, they commence to feed by night, and during the day seek shelter, generally in clusters, on the shady side of tree trunks, beneath large limbs, under rough or loose bark, in holes in trees, under fence rails, in walls, stone heaps, rubbish piles, in short in any accessible place offering shelter from the sun and the birds.

The Pupa. — Gypsy moth pupæ are most abundant during the latter half of July. They are to be found in the same situations as are chosen for depositing the egg clusters, and not infrequently, also, in the foliage of trees and shrubs.

The Moth. — The peculiar zigzag flight of the male moth has already been noted. The large, white, conspicuous female moths sit or crawl on tree trunks, etc., near their pupa cases. In July

(chiefly the latter half) and through August these females may be found busily engaged in laying their eggs.

Danger Signs.—The bristly, cast-off molt skins of the gypsy moth caterpillars, often with the head cases attached, may frequently be found in the situations chosen for the eggs and pupæ. They are often massed in bunches, and are very commonly associated with empty gypsy moth pupa cases or hatched or unhatched gypsy moth egg clusters.

Gypsy moth molt skins and empty pupa cases are resistant to weather and decay, and may be found at any season of the year. The presence in any locality of such molt skin, empty pupa case or hatched egg cluster of the gypsy moth indicates the probable presence near by of the living moth in some form, and therefore is a sign of danger not to be disregarded. The hatched-out egg masses of a previous year often remain intact in sheltered places, and thus give a clue to the presence of the insect.

THE BROWN-TAIL MOTH.

This insect, like the gypsy moth, a common European pest of fruit and shade trees, has been an object of interest to gardeners from the earliest times. Throughout Europe it is known as the "common caterpillar," and accounts of its habits and periodical ravages are to be found in nearly all European works on entomology and horticulture. It found its way accidentally to Somerville, Mass., in the early nineties, probably in a shipment of roses from Holland, multiplied, spread, and is now generally disseminated over eastern New England.

Damage by the Brown-tail Moth.

While at first a pest of the pear and other fruit trees, the brown-tail moth has now adapted itself to feeding on various species of forest trees, notably the oaks. In the spring, as soon as the buds unfold, the young caterpillars begin to feed, and where numerous completely strip even large trees. When the food supply gives out, they swarm forth along fences, walks, etc., in search of foliage.

The damage by the caterpillars to the fruit trees is only a part of the harm wrought by them. Whenever these insects come in contact with human flesh, they produce a most severe and painful nettling. This is due apparently not to any poisonous material in the hairs, but rather to the finely barbed and brittle hairs themselves. So severe is this affection that in many cases people have



Ravages of brown-tail moth caterpillars in neglected pear orchard. Winchester, June, 1905.



Winter webs of brown-tail moth on English oak.

Photo loaned by Chas. Bradley, Superintendent of Farm School, Thompson's Island.
Massachusetts Board of Agriculture, Special Report on
Brown-tail Moth, 1903.

been made seriously ill by it. The best remedy for it is the liberal use of cooling lotions, or what is more satisfactory, even if less pleasant, the free use of common vaseline.

Where the brown-tail moth caterpillar exists in great numbers, it at times gathers upon houses and even enters them, causing extreme annoyance. Like the gypsy moth, the brown-tail moth, where it abounds, depreciates the value of residential property.

Life History.

The Egg. — The egg mass of the brown-tail moth somewhat resembles that of the gypsy moth, but it is laid on the under side of a leaf — seldom on a tree trunk — and is smaller and more elongated and of a brighter reddish-brown color. From July 15 to the end of the month, the white moths lay their eggs in brown, hair-covered masses on the leaves near the top of pear and other trees. Each egg cluster contains about three hundred eggs, closely packed in a mass about two-thirds of an inch long by one-fourth of an inch wide.

The Caterpillar. — The eggs hatch during August, and the young caterpillars begin to feed in clusters on the upper surface of the leaves. They soon commence the work of spinning their winter webs. In making the web a number of leaves in the vicinity of the egg clusters are drawn together and carefully spun in with a tenacious silken web. The web is grayish in color, composed of dead leaves and silk, and is very hard to tear apart. Each web contains about two hundred and fifty caterpillars, and varies in length from four to six inches. With the approach of cold weather the caterpillars enter the web and close the exit holes. We then have the strange phenomenon of a caterpillar wintering over when only one-quarter grown, and emerging the following spring to complete its life history. The extremes of cold in Massachusetts do not seem to affect these insects adversely. They emerge in the spring, usually early in April, eat first the buds and then the blossoms, and attack the foliage of fruit trees as soon as it develops. The full-grown caterpillar is about two inches in length, with a broken white stripe on either side and two conspicuous red dots on the back near the posterior end.

Stripping the foliage of one tree, they go to others, and continue to eat until full grown, when the cocoons are spun within the leaves at the ends of the branches or sometimes on the tree trunks.



FIG. 5. — Winter web of brown-tail moth (reduced).

The Pupa.—The caterpillars pupate within their cocoons at the tips of twigs. Usually the mass of cocoons is formed within a spray of leaves, but at times the cocoon is made on a house wall, fence, tree trunk, etc. The pupa is a compact, dark-brown body, about five-eighths of an inch long, with yellowish-brown hairs scattered over its surface. Pupation takes place the latter part of June, and the moths emerge about the middle of July.

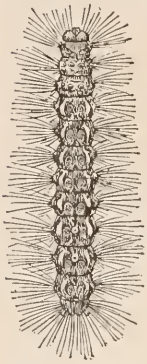


FIG. 6.—Full-grown caterpillar of the brown-tail moth.

The Moth.—The moths are pure white on the wings. The male is slender bodied, while the female has a conspicuous bunch of brown hair at the tip of the abdomen, hence the name “brown-tail moth.” The female has a wing expanse of about one and one-half inches, the male being slightly smaller.

Both the male and female brown-tail moths fly mainly by night, and are greatly attracted to lights. As in the case of the gypsy moth, all the destructive work of the brown-tail moth is done by its caterpillar, which, unlike the gypsy moth caterpillar, habitually feeds by day.

Distribution.

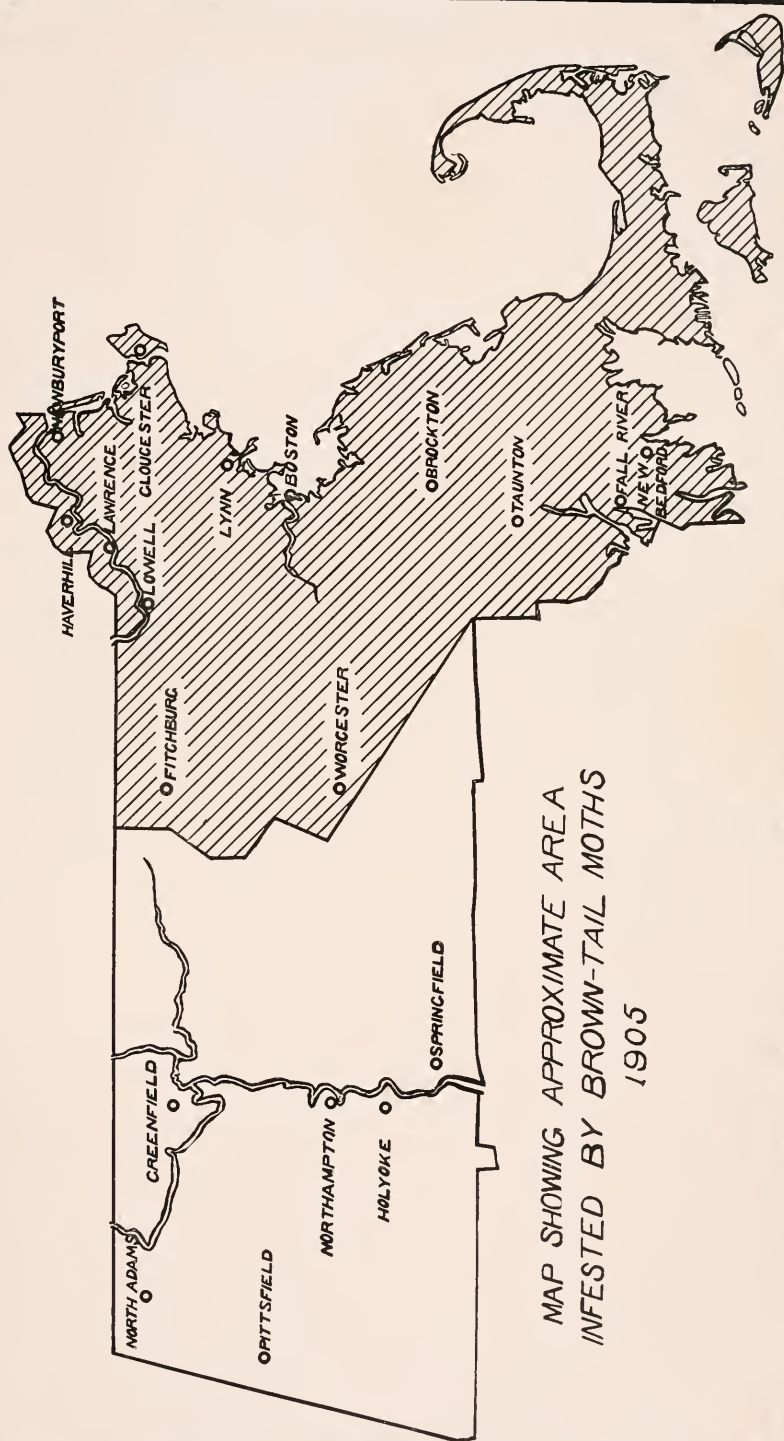
The brown-tail moth is known to have spread at least as far to the northeast as Eastport, Me., and as far south as Cape Cod, Mass. To the west it has been found at Amherst, Mass. The eastern portion of Massachusetts from north to south is now quite solidly infested, though less so south of Boston, and the moth doubtless exists in many communities in and out of Massachusetts from which it has not yet been reported.

The female winged brown-tail moth, like the male, is a strong, swift flyer and can carry her eggs long distances before depositing them. For this reason the brown-tail moth has spread much farther from its point of introduction in Massachusetts than has the gypsy moth. In its flight the brown-tail moth is often aided by strong winds. It is also transported on steamboats and in electric and steam cars to which it is attracted at night by the lights.



FIG. 7.—Female brown-tail moth.

The caterpillar of the brown-tail moth has, when young, the “spinning down” habit already described in the case of the gypsy



MAP SHOWING APPROXIMATE AREA
INFESTED BY BROWN-TAIL MOTHS
1905

moth caterpillar, and is similarly transported by vehicles and pedestrians. The neighborhoods of travelled highways, therefore, should be kept free from the brown-tail as well as from the gypsy moth.

THE SPECIES CONTRASTED.

The gypsy moth and the brown-tail moth are constantly confused in the minds of many people. The following marked differences between the two should be noted:—

a. The egg cluster of the gypsy moth is rarely found on the under side of a leaf, and is commonly a rather robust-looking object, often two inches long and relatively thick and broad.

The egg cluster of the brown-tail moth is almost always deposited on the under side of a leaf, and is smaller and more slender than a typical gypsy moth egg cluster.

b. The gypsy moth caterpillar, when well grown, has a dark grayish or sooty-colored body, marked conspicuously along the back, counting from the head, with a double row of blue spots followed by a double row of red spots.

The brown-tail moth caterpillar, when well grown, is of a bright tawny or orange-brown color, marked along each side of the body by a conspicuous row of pure white spots, and having two bright red spots at the lower end of the back.

c. The female gypsy moth has a wing spread of about two and one quarter inches, and her general color is a dingy white lightly streaked and blotched with blackish and faint grayish. Her abdomen has no thick, conspicuous patch of golden or brownish hairs at the tip. Though she has large wings (which she often flutters), she does not fly, but merely crawls short distances.

The female winged brown-tail moth is much smaller than the female gypsy moth, with much less spread of wing. Her color is a remarkably pure, unsullied, snow white. At the tip of her abdomen is a very conspicuous, unmistakable, sharply contrasted, thick, rounded patch of golden or brownish hairs.

The female brown-tail moth is a swift, strong flyer, mainly flying by night, and is greatly attracted to lights.

d. The gypsy moth caterpillar never weaves a nest or web in which to hibernate during cold weather. The gypsy moth winters in the egg form, never as a caterpillar.

The caterpillar of the brown-tail moth always weaves a hibernating nest or web in which to rest torpid during the winter. Throughout cold weather the brown-tail moth is in caterpillar form, dormant and snugly enshrouded inside its nest, which is placed at or near the tip of a twig. With the warm weather of

spring the brown-tail moth caterpillar does not "hatch", but simply awakens to animation, crawls out of the nest and begins to feed.

e. The gypsy moth does not, in any of its forms, produce noteworthy irritation of the human skin.

The brown-tail moth caterpillars and cocoons, by reason of their hairs, cause a most annoying and painful irritation. The female brown-tail moths, in their struggles to emerge from the cocoons, often acquire a certain number of caterpillar hairs, and hence are sometimes, though rarely, the cause of the irritation above mentioned.

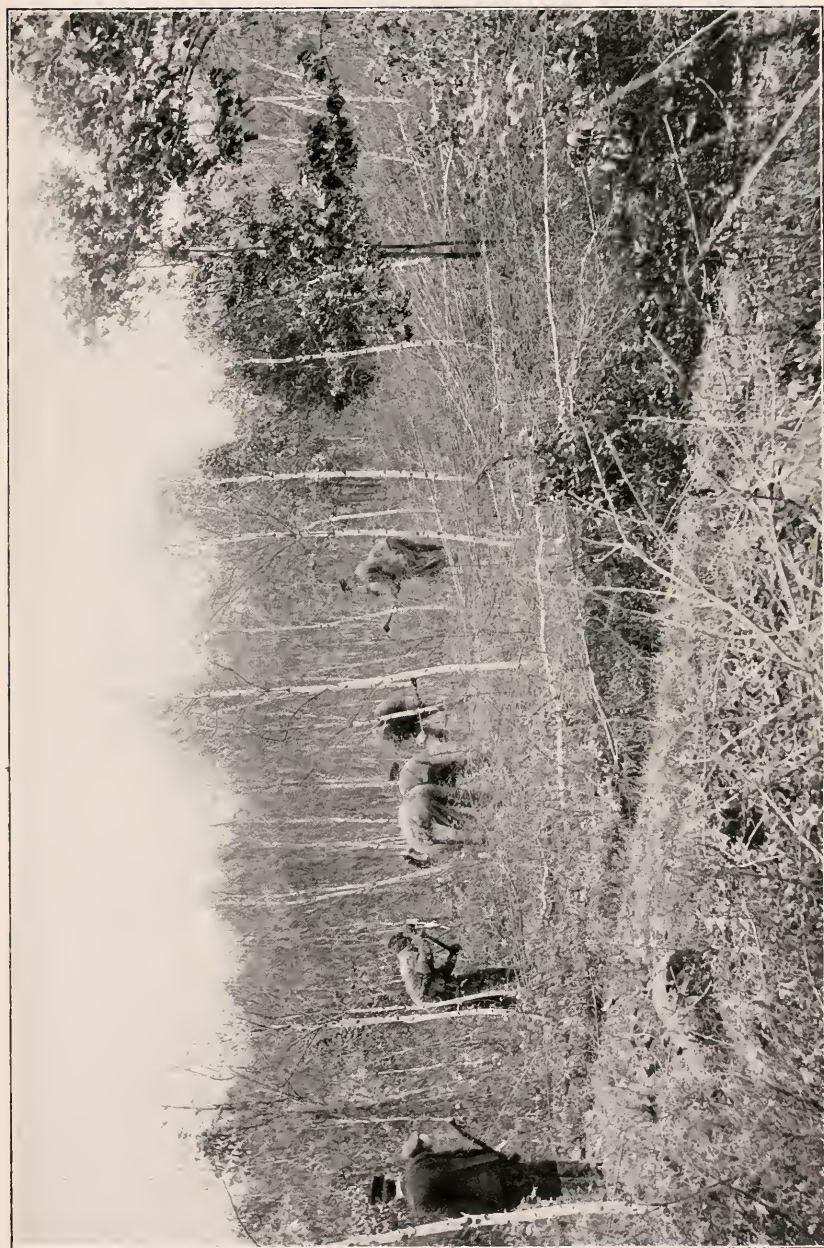
REMEDIES AGAINST THE MOTHS.

The Gypsy Moth.

Egg killing. — No single method of destruction against the gypsy moth is more effective than killing the eggs. The egg masses wherever accessible can be killed from August to May by soaking them thoroughly with creosote mixture. The creosote may be applied with a small swab or paint brush. In killing gypsy moth eggs in high trees, it is usually best to work with two men; one man to point out the egg clusters from the ground, another to kill the eggs in the trees. Creosote mixture may be purchased at agricultural warehouses and seed stores at from fifty cents to one dollar per gallon, depending on quantity.

Where trees and shrubbery (especially low-cost woodland and unimproved tracts of brush) are extensively infested with the eggs of the gypsy moth, the growth should be cut and burned. The eggs are, however, remarkably resistant to fire, and an intense heat applied directly to the clusters is required to kill them all. Where the clusters are very plentiful, burning the ground over with oil to destroy eggs scattered as a result of the cutting of trees and bushes will be required to insure thorough work.

Caterpillar Destruction. — Spraying infested foliage with arsenate of lead at the rate of ten pounds to one hundred gallons of water is very effective when the caterpillars are small. Any of the common hand outfits will suffice for the spraying of shrubs or flowering plants. For use on trees, a pump mounted on a barrel or hogshead is desirable. The poison should be thoroughly mixed in water, and applied, if possible, on a clear, dry day, in such a manner as to cover the leaves, rather slowly, with a fine mist. The foliage should never be drenched with a stream. When the leaves begin to drip, spraying should at once cease. Spraying should begin at the top of the trees. This work is most effective when done during May and early June. Where tall street trees or trees in



Work of removing thick growth from infested sproutland, leaving trees for burlaps.
Massachusetts Board of Agriculture Report, 1899.



Section of burlap band raised, showing gypsy moth caterpillars that had gathered beneath it on the trunk of an elm tree.

Massachusetts Board of Agriculture Report, 1895.

easily accessible woodland are to be sprayed, the use of a power outfit is to be recommended. Steam or gasoline engine sprayers are not so economical of the spray as hand pumps, but make a great saving in the cost of labor. Furthermore, with a properly equipped power outfit the work can be done with the greatest possible rapidity. Where arsenate of lead cannot be obtained, Paris green, one pound to one hundred and fifty gallons of water, may be used, but it should be borne in mind that this insecticide often scorches the foliage, and that it washes off with the first rain. Arsenate of lead is not open to these objections.

Burning over infested wood or brush land in May or June is a very effective method of destroying gypsy moth caterpillars, and is the logical complement to the method of egg killing by burning previously described. The trees and bushes should be cut before the hatching time of the eggs, and may be left lying as they fall. A few trees should be left standing, and to these such caterpillars as escape the burning will resort for food, and they may then be killed by spraying or by burlapping, as described farther on. The burning of the fallen trees and brush should be done when the caterpillars are very young and small. At this time they quickly succumb to flame. When the caterpillars are older, burning is less effective.

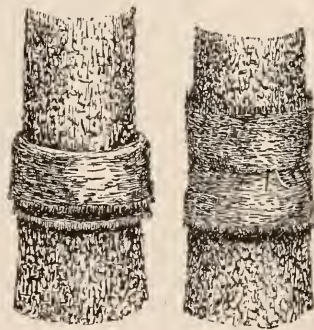


FIG. 8.—Manner of applying the burlap.

If a strip of burlap or other coarse, cheap cloth is tied about an infested tree trunk by the middle, in such manner that the flaps hang down, the caterpillars, as soon as they have acquired the night-feeding habit, will gather under the cloth and can then be destroyed by crushing or by cutting with a sheath knife. The burlaps should be examined daily, or, when the caterpillars are in great numbers in a locality, several times a day. Burlap can be successfully employed from the latter half of May to the first or middle of August, for the caterpillars commonly pupate under burlap and winged moths lay many eggs under it. It should be borne in mind that the cloth band is in no sense a tree protector; nor is it a trap. Its function is simply to give the shelter which the caterpillars seek by day. Serving as it does as a hiding place for various insects, it is better off the tree than on unless it can be attended to and kept clean. At the end of the caterpillar season, all burlaps should be removed and burned. To insure best results

on high trees, such as street elms, burlaps should be placed around some of the larger limbs, as well as around the trunk, as many caterpillars will seek shelter up in the tree rather than descend to the ground. The most effective results in using the burlap are obtained where cavities, crevices, etc., in the trees have been first filled with cement or covered with zinc and all loose bark removed. If these hiding places are destroyed, nearly all the caterpillars will seek the burlap at some time during the season.

Banding a non-infested tree with insect lime or other sticky substance or mixture to keep the caterpillars out of it is an effective means of protection, provided the branches of the tree do not interlock with those of an infested tree, and provided the two do not stand so near that the small caterpillars can pass from the infested tree to the other by means of their fine threads. A band, of whatever material composed, to be effective must remain sticky. When caterpillars are numerous in a place, they often, in their attempts to cross the band, bridge it over with their threads and dead bodies, with the result that other caterpillars coming later are able to ascend the tree. For this reason and in order that the caterpillars which collect beneath may be killed, the sticky band should be frequently inspected. If the many caterpillars which frequently "herd" below the sticky bands are not killed, they will in time leave the trees for shrubbery, where they are less easily destroyed, there to complete their feeding period and transform into moths. Insect lime, raupenleim, tanglefoot, bodlime, printer's ink or even axle grease are among the materials most used for banding. All may be dangerous to the tree and should be removed after the caterpillar season has passed.

Destroying Pupæ and Moths. — Pupæ are commonly found under the burlap and in other places frequented by the caterpillars. They are often massed under large branches or in other sheltered places. In similar locations the female moths may be found in numbers. Both forms of the insect may be crushed by hand to advantage during July and August.

The Brown-tail Moth.

The Eggs. — The gathering of leaves which bear egg masses is only feasible in the case of shrubs and young trees where the foliage may be reached from the ground. Rose bushes, dwarf fruit trees and ornamental shrubs often may be cleared from the moth in this way.

The Caterpillar. — The winter webs or nests containing the hibernating caterpillars are conspicuous objects at the tips of twigs from October to April. These webs should be sought out



Thousands of gypsy moth caterpillars clustered at base of banded tree. The dark portion of the trunk indicates the mass of caterpillars whose farther ascent is prevented by the sticky band. Arlington, June, 1905.



Pupils of Farm School, Thompson's Island, destroying winter webs of brown-tail moth, December, 1902.

Photo loaned by Chas. Bradley, Superintendent of Farm School.
Massachusetts Board of Agriculture, Special Report on Brown-tail Moth, 1903.

and removed by the use of pole shears or long-handled pruners, and then carefully collected and burned. It is more satisfactory, where possible, to burn the webs in a furnace or stove, since, where an open bonfire is used, extra care must be taken to see that none of the webs escape with a mere scorching. When a light snow is on the ground, the work of web destruction and gathering can be carried on to best advantage, although it is desirable that the work should be done as early as possible in the season after the leaves fall. Where tall trees are infested, two men, one to point out the nests from the ground, the other in the tree to cut off the nests, can work more rapidly and economically than one man. It should be borne in mind that webs cut off and thrown on a dump heap as well as those that are beaten off by storms will yield their quota of caterpillars the following spring.

Of all means of combating the brown-tail moth, web destruction as above outlined is the remedy *par excellence*.

Spraying is very effective against brown-tail moth caterpillars, since they are much less resistant to the action of poison than are those of the gypsy moth. To secure best results, spraying should be done as soon as the foliage develops in the spring. Five to eight pounds of the arsenate of lead paste to one hundred gallons of water is sufficient for the spray, or, if preferred, one pound of good Paris green kept well stirred in one hundred and fifty gallons of water may be applied. The directions given for spraying gypsy moth caterpillars should be followed in the case of those of the brown-tail moth. Spraying may be done not only in the spring, but also in August when the caterpillars hatch from the egg, except in cases of trees in fruit.

Spraying or sprinkling with kerosene emulsion or strong soap suds is often useful in destroying the swarming caterpillars on fences, walks, etc.

Such trees as are free from brown-tail moths may be protected from the caterpillars which crawl from neighboring estates by applying a sticky band. The banding will not prevent the infestation of the trees by the female winged moths, which, flying in July, will alight on the foliage of such trees and deposit their egg clusters thereon. It is therefore clear that sticky banding, when used against brown-tail caterpillars, has a more strictly limited usefulness than in the case of the gypsy moth.



FIG. 9.—Pruning shears suitable for removal of winter webs.

The Pupæ.—When the caterpillars have changed to pupæ enclosed by their cocoons, these may be gathered, although the work is likely to be attended by severe inflammation of the skin from contact with the nettling hairs. Cocoons thus gathered should be placed in a barrel covered with mosquito netting, so that any parasites may escape while the moths are confined. Brown-tail moth pupæ are most numerous during the latter half of June.

The Moths.—As has been already mentioned, the moths assemble in great numbers around electric and other lights. It often occurs on a morning during the flying season that a lamp pole is covered by hundreds if not thousands of the winged moths. In such cases the free use of the hose will wash down and kill the insects. No effective form of lamp trap has yet been devised, and, in fact, it is not at all clear that the brown-tail moth can be combated economically in the winged stage.

INSECTS MISTAKEN FOR THE GYPSY AND BROWN-TAIL MOTHS.

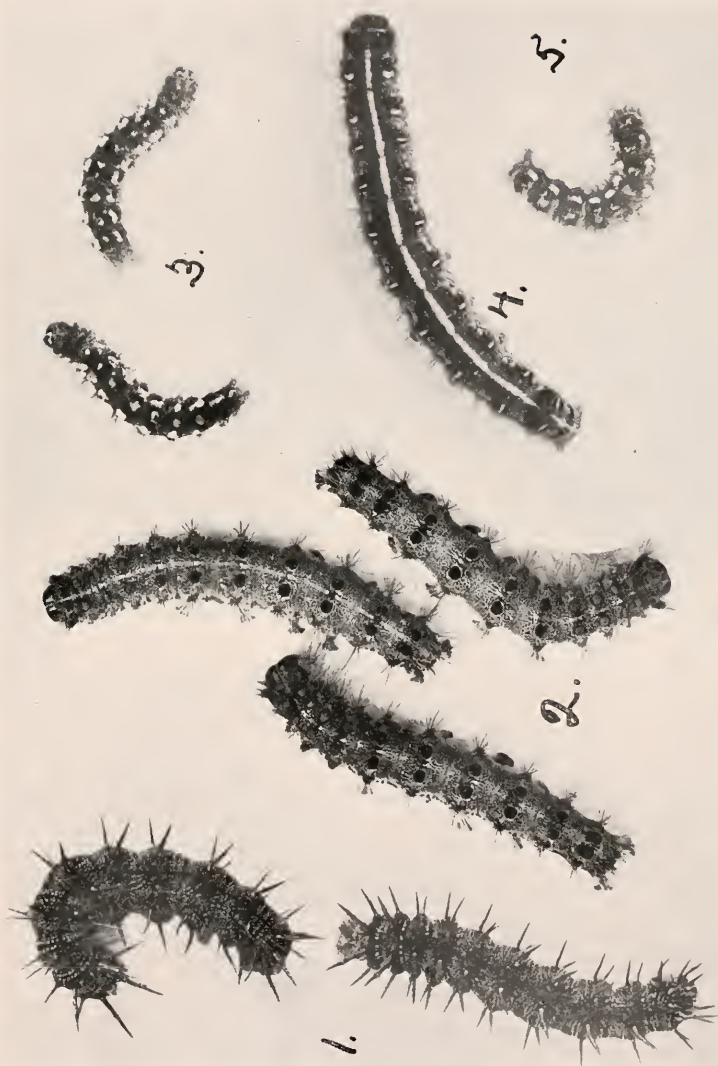
Owing to the growing public interest in injurious insects, doubtless due in part to the fear of the moth pests, it seems desirable to include at this point a brief description of the insects commonly mistaken for either gypsy or brown-tail moths, together with the remedies applicable to each species.

Tent Caterpillar.

Eggs: laid in midsummer in a compact, varnish-covered band around twigs of apple, wild cherry, etc. *Larva:* appears late in April, and feeds to June 1–10. The full-grown caterpillar has a conspicuous, light yellow stripe along the back, which distinguishes it from the larva of the gypsy or of the brown-tail moth; the white webs spun by the caterpillars in the forks of branches also serve to distinguish this species from the two others. *Cocoon:* cream colored, containing a notable quantity of sulphur yellow powder, spun on bark, fences or other sheltered places. *Moth:* reddish brown, spread about $\frac{3}{4}$ to 1 inch, flying principally by night. *Remedy:* spray with arsenate of lead, 3 pounds to 50 gallons of water, as soon as webs are noticed.

Forest Tent Caterpillar.

Eggs: laid on twigs of forest trees, the ends of the egg band being square cut instead of rounded, as in preceding species. *Larva:* conspicuously marked with a broken row of cream colored spots along back; other stages similar to preceding species. These



1. Vanessa larvæ. 2 Gypsy moth larvæ. 3 and 5. Brown-tail moth larvæ.
4. Tent caterpillar (slightly enlarged).



Egg clusters mistaken for that of the gypsy moth.

1. *Orgyia leucostigma*.
2. *O. antiqua*.
3. *O. defnita*.
4. Brown-tail moth web.

Cocoons mistaken for brown-tail moth web.

5. *Actias luna*.
6. *Attacus cecropia*.
7. *Telega polyphemus*.
8. *Callosamia promethea*.

insects sometimes cause severe damage to sugar orchards. *Remedy*: spray about May 15 with arsenate of lead, 3 pounds to 50 gallons of water.

Canker Worms.

These insects of two similar species are true loopers or inch worms. *Eggs*: laid in small masses on bark of infested trees in fall or spring. *Larva*: generally dark colored, with variable faint yellowish stripes. The feeding period extends from May 1 to about June 20, badly infested trees appearing as if swept by fire. *Pupa*: formed in an earthen cell at variable depth in the ground. *Moth*: ashy gray in case of male, dull gray in case of female which is wingless, and is obliged to crawl up the tree in order to deposit her eggs. *Remedies*: banding the trees with sticky materials in November will intercept the female moths of the fall species. The same treatment repeated in March and April will prevent the ascent of the spring canker worm. Spraying about May 15 with arsenate of lead, 3 pounds to 50 gallons of water, is also an effective remedy.

Plant Lice.

These insects feed on plant juices, and are best combated by spraying with kerosene emulsion, 1 part to 9 of water, or with whale oil soap, 1 pound to 8 gallons of water. The elm leaf louse curls the terminal leaves of elm twigs early in the spring. A like effect is produced on the apple by the common green aphid, and the cherry and peach are afflicted by a plant louse of similar habits. The important thing in treating these insects is to drive the spray forcibly into the curled leaves, and to make a second treatment about one week after the first spraying. With plant lice it is a general rule that by midsummer their natural enemies develop in sufficient numbers to check their increase.

Spiny Elm Caterpillar (Vanessa).

Eggs: laid early in the spring in a band around twigs of elm, willow or poplar. *Larva*: the dark colored spiny caterpillars feed in clusters, and commonly strip one or more branches by June 25 at about which date they descend the trees to transform. Occasionally an entire tree is defoliated. *Pupa*: dull grayish, armed with short spines; usually found under fences and in sheltered places. *Butterfly*: expands $2\frac{1}{2}$ inches, very dark brown with a conspicuous yellow border. The second brood of caterpillars appears in August, and the butterflies winter under bark, in

walls, etc. *Remedy*: the caterpillars may be jarred off and crushed under foot, or the branch which they infest may be cut off and burned. Spraying with arsenate of lead, 3 pounds to 50 gallons of water, is completely effective.

Tussock Moth (Orgyia).

Eggs: laid in a white, froth-covered mass on the old cocoon on the bark of elm, horse chestnut, pear and other trees. *Larva*: appears about June 1st, and when full grown is yellowish gray in color with a red head and with two pencils of black hair pointing forward from the head and a single pencil pointing backward from the tip of the body. There are also four dense tufts of white hair on the back. *Cocoon*: spun on bark, fences and house walls. *Moth*: the male is of a chocolate brown color and expands about $\frac{3}{4}$ inch; female, light gray, spider-like and wingless. There is usually a second brood in late summer. Of the two allied species *O. definita* covers the egg mass with brownish hair and has a conspicuously yellow caterpillar, while *O. antiqua* lays a naked egg mass and has dark colored caterpillars. The latter species is most common on the apple and the willow. *Remedy*: creosote, or collect and burn the egg mass in the winter; spray with arsenate of lead, 3 pounds to 50 gallons of water, as soon as the small caterpillars are noticed.

Imported Elm Leaf Beetle.

Eggs: laid in June in small, compact clusters on under side of leaf of elm. The egg clusters resemble those of the potato beetle but are smaller and of a lighter yellow color. *Larva*: the slugs feed almost wholly on the lower side of the leaf, consuming the epidermis and leaf tissue. By July 15 infested trees often appear as if swept by fire. When full grown the slugs are about $\frac{1}{2}$ inch long, and are light yellow in color with black markings on either side of the body. *Pupæ*: small, orange colored bodies, found in great masses at base of tree or in rough bark. *Beetle*: about $\frac{1}{3}$ inch long, dull smoky yellow, with dark bordered wings. A partial second brood occurs in some seasons. The mature beetle hibernates under shingles and clapboards of buildings, under rough bark and in various sheltered places. Their early feeding in spring causes the trees to appear as if riddled by shot. *Remedy*: spray early in June with arsenate of lead, 5 pounds to 50 gallons of water. Use kerosene emulsion, strong soap suds, or hot water on the masses of pupæ around the base of infested trees. The principal dependence must be put on spraying.

Web Worm.

The fall web worm is often mistaken for the brown-tail moth caterpillar, but its webs are larger and much more conspicuous. *Eggs*: laid by the moth in a small patch on the under side of the leaf of various trees late in June. *Larva*: feeds within a web which by late summer is often several feet in diameter. The full grown caterpillar is about $1\frac{1}{2}$ inches long with yellowish, longitudinal markings and clothed with slender grayish hairs. In September the caterpillars pupate in the ground to emerge as snow white moths in early summer. *Remedy*: spray with arsenate of lead, 3 pounds to 50 gallons of water, as soon as the first webs are noticed. Trees of which the fruit is nearly ripe should not be sprayed; in this case the judicious use of the torch is recommended.

Fall Caterpillars.

Several species of caterpillars appearing in August–September are often mistaken for those of the gypsy moth, and may be treated collectively. The red-humped apple worm occurs principally on the apple, is about $1\frac{1}{2}$ inches long, and is characterized by a conspicuous, transverse, red hump near the head. The *Datanus* of several species are slightly larger than the preceding, feed in clusters on the apple, hickory, etc., and have the habit of raising both ends of the body when disturbed. The species most common on fruit trees is dark yellow with numerous fine black lines, while another often abundant on forest trees is black with conspicuous white hairs. The characteristics mentioned distinguish them from the gypsy moth caterpillars. *Remedy*: spray with arsenate of lead, 5 pounds to 50 gallons of water; recommended except on trees with fruit nearly ripe. In this case the torch may be carefully used, or the caterpillars may be jarred off and crushed under foot.

A SUMMARY OF THE LAW.

In the suppression of the gypsy and brown-tail moths, certain duties under the law devolve not only upon the Commonwealth but also upon cities and towns and upon citizens as individuals. Attention is hereby called to chapter 381, Acts of 1905, as amended by chapter 268, Acts of 1906, which defines these duties at length and which is printed in full at the end of this bulletin.

The following summary of the law is designed to give its salient points:—

The Moths are Public Nuisances.

The gypsy and brown-tail moths are declared public nuisances and their suppression is required.

The Superintendent of Suppression.

A superintendent, appointed by the Governor, with power, subject to the Governor's approval, of appointing agents and assistants, has entire general charge of the work of suppressing the moths.

Duties of Cities, Towns and Individuals.

Cities and towns (under the advice and general direction of the superintendent, and by such agent as they may designate or appoint) are required, under penalty for neglect, to destroy the eggs, caterpillars, pupæ and nests of the gypsy and the brown-tail moths within their limits:

Excepting that such work is not to be done by cities and towns on property controlled by the Commonwealth; nor is it to be done upon private property, excepting where the owners of the same fail to destroy the eggs, caterpillars, pupæ and nests of the moths, in accordance with the terms of the official notice to private owners, noted in the section here following:—

Notice to Private Owners.

The mayor of every city and the selectmen of every town shall, at suitable times, notify every owner of land located therein which is infested with the moths, requiring him to destroy the eggs, caterpillars, pupæ and nests of the moths within a specified time.

When the mayor or selectmen decide that the cost of such destruction (on lands contiguous and under one ownership) will exceed one-half of one per cent of the assessed valuation of the lands, then they may designate in the notice a part only of such lands on which the destruction shall take place.

Failure of Private Owners to destroy Moths.

If the owner does not, as required by the terms of the aforesaid notice, destroy the eggs, caterpillars, pupæ and nests of the moths, then the city or town, subject to the approval of the state superintendent, shall destroy them, and shall assess upon such aforesaid lands the actual cost of so doing, to an amount, however, not ex-

ceeding one-half of one per cent of the assessed valuation of the land.

This amount, so assessed, shall be collected in the form of taxes, and constitutes a lien upon such lands.*

Redress by Abatement and Appeal.

The assessors may abate the moth assessment in the case of any private land owner decided by them to be unable to pay it because of age, infirmity or poverty.

Appeal to the county superior court, with special provision for prompt hearing, is provided by the statute for any person aggrieved by assessment on account of this work; provided a complaint is entered within thirty days of notice of such assessment.

Appropriation by the Commonwealth.

To meet the expenses incurred under its moth-suppression law, the Commonwealth appropriated in 1905 \$300,000, of which \$75,000 might be expended during 1905, \$150,000 (and any unexpended balance) during 1906, and \$75,000 (and any unexpended balance) during 1907, up to May 1, 1907, inclusive.†

For the purpose of experimenting with natural enemies for destroying the moths, \$10,000 was additionally appropriated for each of the years 1905, 1906 and 1907.

Reimbursements to Cities and Towns.

1. Cities and towns with valuation of real and personal estate of \$12,500,000 or more, having spent \$5,000 in any one calendar year, shall be reimbursed annually 50 per cent (one-half) of all further expenditure.

2. Cities and towns, with valuation less than \$12,500,000 and more than \$6,000,000, having spent an amount equal to one-twenty-fifth of one per cent of such valuation in one year, shall be reimbursed annually 80 per cent (four-fifths) of all further expenditure.

3. Towns with valuation less than \$6,000,000, having spent an amount equal to one-twenty-fifth of one per cent of such valuation in one year, shall be reimbursed once in sixty days for *all* further expenditure.

* By a recent ruling of the Attorney-General the word "lands" is held to include lands with buildings thereon.

† An additional appropriation of \$75,000 for suppressing the gypsy and brown-tail moths was made by the legislature, May 8, 1906.

Limits to required Expenditure by Cities and Towns.

No city or town with an assessed real and personal valuation of *more* than \$6,000,000 shall be required to expend in the suppression of the moths during any one full year more than one-fifteenth of one per cent of such valuation. No town with an assessed real and personal valuation of *less* than \$6,000,000 shall be required to thus expend during any one full year more than one-twenty-fifth of one per cent of such valuation.

Valuations of 1904 taken as a Basis.

Wherever valuations of real and personal property are referred to in the gypsy and brown-tail moth suppression law, the valuations of 1904 are meant.

Wilful Resistance and Failure to comply with Rules.

A person who wilfully resists or obstructs any agent of the Commonwealth or of any city or town while lawfully engaged in the execution of the purposes of the act relative to suppressing the moths, or who knowingly fails to comply with any of the rules or regulations issued by the superintendent shall forfeit a sum not exceeding \$25 for each offence.

PENALTY FOR TRANSPORTING MOTHS.

[SEC. 108, CHAP. 208, REVISED LAWS.]

Whoever knowingly brings the insects which are known as the oeneria dispar or gypsy moth or as the brown-tail moth, or their nests or eggs, into this commonwealth, or whoever knowingly transports said insects or their eggs or nests from one city or town to another city or town in the commonwealth, except when engaged in, and for the purpose of, destroying them shall be punished by a fine of not more than two hundred dollars or by imprisonment for not more than sixty days, or by both such fine and imprisonment.

[UNITED STATES STATUTES AT LARGE, VOL. 33, PART 1, CHAP. 1501. AN ACT TO PROHIBIT IMPORTATION OR INTERSTATE TRANSPORTATION OF INSECT PESTS AND THE USE OF THE UNITED STATES MAILS FOR THAT PURPOSE.]

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That no railroad, steamboat, express, stage or other transportation company shall

knowingly transport from one State or Territory into any other State or Territory, or from the District of Columbia into a State or Territory, or from a State or Territory into the District of Columbia, or from a foreign country into the United States, the gypsy moth, brown-tail moth, leopard moth, plum curculio, hop plant-louse, boll weevil, or any of them in a live state, or other insect in a live state which is notoriously injurious to cultivated crops, including vegetables, field crops, bush fruits, orchard trees, forest trees, or shade trees; or the eggs, pupæ, or larvæ of any insect injurious as aforesaid, except when shipped for scientific purposes under the regulations hereinafter provided for; nor shall any person remove from one State or Territory into another State or Territory, or from a foreign country into the United States, or from a State or Territory into the District of Columbia, or from the District of Columbia into any State or Territory, except for scientific purposes under the regulations hereinafter provided for, the gypsy moth, brown-tail moth, leopard moth, plum curculio, hop plant-louse, boll weevil, or any of them in a live state, or other insect in a live state which is notoriously injurious to cultivated crops, including vegetables, field crops, bush fruits, orchard trees, forest trees, or shade trees; or the eggs, pupæ, or larvæ of any insect injurious as aforesaid.

SEC. 2. That any letter, parcel, box, or other package containing the gypsy moth, brown-tail moth, leopard moth, plum curculio, hop plant-louse, boll weevil, or any of them in a live state, or other insect in a live state which is notoriously injurious to cultivated crops, including vegetables, field crops, bush fruits, orchard trees, forest trees, or shade trees, or any letter, parcel, box, or package which contains the eggs, pupæ, or larvæ of any insect injurious as aforesaid, whether sealed as first-class matter or not, is hereby declared to be nonmailable matter, except when mailed for scientific purposes under the regulations hereinafter provided for, and shall not be conveyed in the mails, nor delivered from any post-office, nor by any letter carrier, except when mailed for scientific purposes under the regulations hereinafter provided for; and any person who shall knowingly deposit, or cause to be deposited, for mailing or delivery, anything declared by this section to be nonmailable matter, or cause the same to be taken from the mails for the purpose of retaining, circulating, or disposing of, or of aiding in the retention, circulation, or disposition of the same shall, for each and every offense, be fined, upon conviction thereof, not more than five thousand

dollars or imprisoned at hard labor not more than five years, or both, at the discretion of the court: Provided, That nothing in this Act shall authorize any person to open any letter or sealed matter of the first-class not addressed to himself.

SEC. 3. That it shall be the duty of the Secretary of Agriculture, and he is hereby authorized and directed to prepare and promulgate rules and regulations under which the insects covered by sections one and two of this Act may be mailed, shipped, transported, delivered, and removed, for scientific purposes, from one State or Territory into another State or Territory, or from the District of Columbia into a State or Territory, or from a State or Territory into the District of Columbia, and any insects covered by sections one and two of this Act may be so mailed, shipped, transported, delivered, and removed, for scientific purposes, under the rules and regulations of the Secretary of Agriculture: Provided, That the rules and regulations of the Secretary of Agriculture, in so far as they affect the method of mailing insects, shall be approved by the Postmaster-General, and nothing in this Act shall be construed to prevent any State from making and enforcing laws in furtherance of the purpose of this Act, prohibiting or regulating the admission into that State of insects from a foreign country.

SEC. 4. That any person, company, or corporation who shall knowingly violate the provisions of section one of this Act shall, for each offense, be fined, upon conviction thereof, not more than five thousand dollars or imprisoned at hard labor not more than five years, or both, at the discretion of the court.

Approved, March 3, 1905.

WARNING.

Many property owners prefer to hire experts to destroy the moth pests on their estates, and this is often the most economical and effective plan, particularly in the case of the gypsy moth. This office has prepared a list of reliable persons who are engaged in the work of moth suppression as a business, and the same may be had on request. It should be understood, however, that the superintendent assumes no responsibility for the success or the cost of such work.

It is to be regretted that several unscrupulous persons have made a practice of applying worthless treatment to trees, at large cost to the owner, and even, in some cases, have claimed that they were official representatives of this office. It should be clearly

understood that no employee of this office is authorized to do such work, to be paid for directly by property owners. Any case of a person making representations to the contrary should be brought to the attention of the police and this office notified.

The superintendent has organized a small corps of trained agents and inspectors who are engaged in examining the infested territory and in directing the work of the various cities and towns. The central office is prepared to advise officials in charge of local work, as well as private citizens, concerning the best methods of combating the moths, and to render any assistance in its power.

If our trees are to be saved from these insects, the hearty co-operation of all citizens will be necessary. Without such co-operation little can be accomplished; with it, the pests can be brought under control.

A. H. KIRKLAND,
Superintendent.

OFFICE, 6 BEACON STREET, BOSTON, MASS.

Connected by telephone.



LAW RELATING
TO
GYPSY AND BROWN TAIL MOTHS.

[CHAP. 381, ACTS OF 1905, AS AMENDED BY CHAP. 268, ACTS OF 1906.]

AN ACT TO PROVIDE FOR SUPPRESSING THE GYPSY AND BROWN TAIL MOTHS.

Be it enacted, etc., as follows:

SECTION 1. For the purposes of this act the pupæ, nests, eggs and caterpillars of the gypsy and brown tail moths and said moths are hereby declared public nuisances, and their suppression is authorized and required; but no owner or occupant of an estate infested by such nuisance shall by reason thereof be liable to an action, civil or criminal, except to the extent and in the manner and form herein set forth.

SECTION 2. The governor, by and with the consent of the council, shall appoint a superintendent for suppressing the gypsy and brown tail moths and shall determine his salary. The governor may, with the consent of the council, remove said superintendent at any time for such cause as he shall deem sufficient. In case of the death, removal or resignation of the superintendent the governor shall forthwith appoint a successor. On or before the third Wednesday in January in each year the superintendent shall make a report of his proceedings to the general court, which shall be a public document and shall be printed. Said report shall separate so far as is practicable the expenditures on work against the gypsy moth from those on work against the brown tail moth in each city and town.

SECTION 3. [As amended by section 1, chapter 268, Acts of 1906.] The said superintendent shall act for the Commonwealth in suppressing said moths as public nuisances, in accordance with the provisions of this act. For this purpose he shall establish an office and keep a record of his doings and of his receipts and expenditures, and may, subject to the approval of the governor, make rules and regulations governing all operations by cities, towns or individuals under this act. He may employ such clerks, assistants and agents, including expert advisers and inspectors, as he may deem necessary and as shall be approved by the governor. He may make contracts on behalf of the Commonwealth; may act in co-operation with any person, persons, corporation or corporations, including other states, the United States or foreign governments; may conduct investigations and accumulate and distribute information con-

cerning said moths; may devise, use and require all other lawful means of suppressing or preventing said moths; may lease real estate when he deems it necessary, and, with the approval of the board in charge, may use any real or personal property of the Commonwealth; may at all times enter upon the land of the Commonwealth or of a municipality, corporation, or other owner or owners, and may use all reasonable means in carrying out the purposes of this act; and, in the undertakings aforesaid, may, in accordance with the provisions of this act, expend the funds appropriated or donated therefor; but no expenditure shall be made or liability incurred in excess of such appropriations and donations.

SECTION 4. [As amended by section 2, chapter 268, Acts of 1906.] Cities and towns by such public officer or board as they shall designate or appoint, shall, under the advice and general direction of said superintendent, destroy the eggs, caterpillars, pupæ and nests of the gypsy and brown tail moths within their limits, except in parks and other property under the control of the Commonwealth, and except in private property, save as otherwise provided herein. When any city or town shall have expended within its limits city or town funds to an amount in excess of five thousand dollars in any one calendar year, in suppressing gypsy or brown tail moths, the Commonwealth shall reimburse such city or town to the extent of fifty per cent of such excess above said five thousand dollars.

Cities or towns, where one twenty-fifth of one per cent of the assessed valuation of real and personal property is less than five thousand dollars, and where the assessed valuation of real and personal property is greater than six million dollars, shall be reimbursed by the Commonwealth to the extent of eighty per cent of the amount expended by such cities or towns of city or town funds in suppressing the gypsy and brown tail moths in any one calendar year, in excess of said one twenty-fifth of one per cent.

In the case of towns where the assessed valuation of real and personal property is less than six million dollars, after they have expended in any one calendar year town funds to an amount equal to one twenty-fifth of one per cent of their assessed valuation of real and personal property, the Commonwealth shall expend within the limits of such towns, for the purpose of suppressing the gypsy and brown tail moths, such an amount in addition as the superintendent with the advice and consent of the governor shall recommend. Disbursements made by said last named towns in excess of said one twenty-fifth of one per cent shall be reimbursed by the Commonwealth every sixty days; but in the case of all others the Commonwealth shall reimburse cities and towns annually according to the provisions of this act.

No city or town shall be entitled to any reimbursement from the Commonwealth until it has submitted to the auditor of the Commonwealth itemized accounts and vouchers showing the definite amount expended by it for the purpose of this act; nor shall any money be paid out of the treasury of the Commonwealth to cities or towns, pursuant to the pro-

visions of this act, until said vouchers and accounts have been approved by the superintendent and the auditor of the Commonwealth.

For the purposes of this section the years nineteen hundred and five and nineteen hundred and seven shall be considered half years, and the valuation for the year nineteen hundred and four shall be taken as a basis.

SECTION 5. [As amended by section 3, chapter 268, Acts of 1906.] When, in the opinion of the superintendent, any city or town is not expending a sufficient amount for the abatement of said nuisance, or is not conducting the necessary work in a proper manner, then the superintendent shall, with the advice and consent of the governor, order such city or town to expend such an amount as the superintendent shall deem necessary, and in accordance with such methods as the superintendent, with the consent of the governor, shall prescribe: *provided*, that no city or town where the assessed valuation of real and personal property exceeds six million dollars shall be required to expend, exclusive of any reimbursement received from the Commonwealth, during any one full year more than one fifteenth of one per cent of such valuation, and that no town where the assessed valuation of real and personal property is less than six million dollars shall be required to expend, exclusive of any reimbursement received from the Commonwealth, during any one full year more than one twenty-fifth of one per cent of such valuation. For the purposes of this section the valuation of the year nineteen hundred and four shall be used.

Any city or town failing to comply with the directions of the said superintendent in the performance of said work within the date specified by him shall pay a fine of one hundred dollars a day for failure so to do; said fine to be collected by information brought by the attorney-general in the supreme judicial court for Suffolk county.

SECTION 6. [As amended by section 4, chapter 268, Acts of 1906.] The mayor of every city and the selectmen of every town shall, on or before the first day of November in each year, and at such other times as he or they shall see fit, or as the state superintendent may order, cause a notice to be sent to the owner or owners, so far as can be ascertained, of every parcel of land therein which is infested with said moths; or, if such notification appears to be impracticable, then by posting such notice on said parcels of land, requiring that the eggs, caterpillars, pupæ and nests of said moths shall be destroyed within a time specified in the notice.

When, in the opinion of the mayor or selectmen, the cost of destroying such eggs, caterpillars, pupæ and nests on lands contiguous and held under one ownership in a city or town shall exceed one half of one per cent of the assessed value of said lands, then a part of said premises on which said eggs, caterpillars, pupæ or nests shall be destroyed may be designated in said notice, and such requirement shall not apply to the remainder of said premises. The mayor or selectmen may designate the manner in which such work shall be done, but all work done under this section shall be subject to the approval of the state superintendent.

If the owner or owners shall fail to destroy such eggs, caterpillars, pupæ or nests in accordance with the requirements of the said notice, then the city or town, acting by the public officer or board of such city or town designated or appointed as aforesaid, shall, subject to the approval of the said superintendent, destroy the same, and the amount actually expended thereon, not exceeding one half of one per cent of the assessed valuation of said lands, as heretofore specified in this section, shall be assessed upon the said lands; and such an amount in addition as shall be required shall be apportioned between the city or town and the Commonwealth in accordance with the provisions of section four of this act. The amounts to be assessed upon private estates as herein provided shall be assessed and collected, and shall be a lien on said estates, in the same manner and with the same effect as is provided in the case of assessments for street watering.

SECTION 7. [As amended by section 5, chapter 268, Acts of 1906.] If, in the opinion of the assessors of a city or town, any land therein has received, by reason of the abatement of said nuisances thereon by said superintendent or by said city or town, a special benefit beyond the general advantage to all land in the city or town, then the said assessors shall determine the value of such special benefit and shall assess the amount thereof upon said land: *provided*, that no such assessment on lands contiguous and held under one ownership shall exceed one half of one per cent of the assessed valuation of said lands; and *provided*, that the owner or owners shall have deducted from such assessment the amount paid and expended by them during the twelve months last preceding the date of such assessment toward abating the said nuisances on said lands, if, in the opinion of the assessors, such amount has been expended in good faith. Such assessment shall be a lien upon the land for three years from the first day of January next after the assessment has been made, and shall be collected under a warrant of the assessors to the collector of taxes of such city or town, in the manner and upon the terms and conditions and in the exercise of the powers and duties, so far as they may be applicable, prescribed by chapter thirteen of the Revised Laws relative to the collection of taxes.

Real estate sold hereunder may be redeemed within the time, in the manner, and under the provisions of law, so far as they may be applicable, set forth in chapter thirteen of the Revised Laws for the redemption of land sold for taxes.

A person aggrieved by such assessment may appeal to the superior court for the county in which the land lies, by entering a complaint in said court within thirty days after he has had actual notice of the assessment, which complaint shall be determined as other causes by the court without a jury. The complaint shall be heard at the first sitting of said court for trials without a jury after its entry; but the court may allow further time, or may advance the case for speedy trial, or may appoint an auditor as in other cases. The court may revise the assessment, may allow the recovery back of an amount wrongfully assessed which has

been paid, may set aside, in a suit begun within three years from the date thereof, a collector's sale made under an erroneous assessment, may award costs to either party and may render such judgment as justice and equity require.

If, in the opinion of the assessors, the owner of an estate upon which an assessment as aforesaid has been made is, by reason of age, infirmity or poverty unable to pay the assessment, they may upon application abate the same. Every city or town in rendering an account to the state auditor as provided for in section four of this act shall deduct from such amount as it has expended the total amount it has received for work performed under section six of this act during the term covered by the account: *provided*, such work was performed under such conditions as require reimbursement in whole or in part by the state.

SECTION 8. To meet the expenses incurred under authority of this act, there shall be allowed and paid out of the treasury of the Commonwealth, during the period up to and including May first, nineteen hundred and seven, the sum of three hundred thousand dollars. Of this amount seventy-five thousand dollars may be expended during the calendar year nineteen hundred and five; one hundred and fifty thousand dollars, and any unexpended balance of the previous year, may be expended during the calendar year nineteen hundred and six; and seventy-five thousand dollars, and any unexpended balance of the previous years, may be expended during the calendar year nineteen hundred and seven, up to and including May first.

SECTION 9. An additional sum of ten thousand dollars in each of the years nineteen hundred and five, nineteen hundred and six and nineteen hundred and seven may, in the discretion of the state superintendent, be expended by him for experimenting with parasites or natural enemies for destroying said moths, and any unexpended balance of any year may be expended in the subsequent years.

SECTION 10. Chapter two hundred and ten of the acts of the year eighteen hundred and ninety-one and sections one and two of chapter five hundred and forty-four of the acts of the year eighteen hundred and ninety-eight and section two of chapter fifty-seven of the acts of the year nineteen hundred and two, are hereby repealed.

SECTION 11. [As amended by section 6, chapter 268, Acts of 1906.] A person who wilfully resists or obstructs the superintendent or an official of a city or town, or a servant or agent duly employed by said superintendent or by any of said officials, while lawfully engaged in the execution of the purposes of this act, or who knowingly fails to comply with any of the rules or regulations issued by said superintendent, shall forfeit a sum not exceeding twenty-five dollars for each offence.

SECTION 12. Valuations of real and personal property of the year nineteen hundred and four shall govern the provisions of this act.

SECTION 13. This act shall take effect upon its passage. [*Approved May 8, 1905.*]

